SMAPsim: An Australian airborne active-passive simulator for the SMAP mission

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Introduction

A combined active/passive microwave airborne facility is currently being developed through support of the Australian Research Council.

This new facility will allow collection of data which are a scaled replicate of SMAP acquisition in terms of incidence angles, polarizations, swath coverage and resolution ratio between active and passive data. This will allow development of the active microwave soil moisture retrieval algorithms and combined active/passive microwave downscaling techniques needed to obtain high resolution soil moisture maps from SMAP data.

The Facility

The facility includes (see Fig 1):

- A polarimetric L-band fully focused Synthetic Aperture Radar with interferometric capabilities (InSAR) having a spatial resolution of 10m at 3km flying height.
- A dual polarisation L-band passive microwave radiometer with 1km resolution at 3km flying height.

Additional instruments include:

- A FLIR Thermacam S60 thermal infrared imager with a 80° × 60° FOV and 20m spatial resolution at 3km flying height and six, 15° FOV thermal infrared radiometers for soil/canopy temperature.
- An R/G/B/NIR sensor with a 24º or 45º FOV (depending on lens) and 1m resolution at 3km flying height for vegetation water content.
- A Riegl LMS-Q280i full waveform LIDAR with range of 30m to 1500m for ground/vegetation elevation, vegetation structure, and potentially vegetation water content.
- Digital video and high resolution (21 MegaPixel) digital camera with a 23 or 84º FOV (depending on settings).

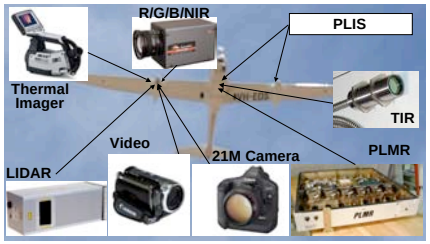

Fig 1: Schematic of the airborne facility with proposed Installation of the PLIS radar together with supporting instrumentation

The Platform

Two aircraft platforms will be available to operate the instruments with the following characteristics:

Platform 1:

- Typical science payload: 120kg,
- Cruising speed: 90m/s (200km/h), and
- Range: 5hrs.

Platform 2:

- Typical science payload 250kg,
- Cruising speed 160m/s (280km/h), and
- Range: 9hrs.

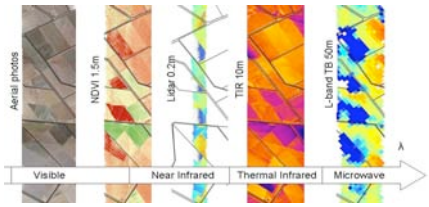

Fig 2: Example of multi-sensor airborne acquisitions using the airborne facility described (minus radar) over an irrigation area.

The Radiometer

The Polarimetric L-band Multibeam Radiometer (PLMR) has been extensively flown over Australian and European sites since 2005.

PLMR specifications are:

- Frequency/bandwidth: 1.413GHz/24MHz,
- Polarisations: V and H using a single receiver with polarisation switch,
- Resolution: 1km at 3km flying height,
- NEDT: <1K for an integration time of 0.5s,
- Repeatability: 1K over 4 hours,
- Incidence angles: +/- 7°, +/-21.5°, +/- 38.5° @ pushbroom,
- Antenna type: 8x8 patch array,
- Weight: 46kg, and
- Size 91.5cm × 91.5cm × 17.25cm.

The Radar

The polarimetric L-band Imaging Scatterometer (PLIS, Fig.3) is scheduled for delivery by mid 2009. We expect the instrument to be available for general use from end of 2009.

PLIS specifications are:

- Frequency/bandwidth: 1.26GHz/80MHz,
- Polarisations: VV, VH, HV and HH,
- Resolution: 10m at 3km flying height,
- Accuracy: 2db
- PRF: up to 20KHz,
- Pulse widths: 50ns-5µ,
- Incidence angles 14º -45º
- Antenna type:2x2 patch array,
- Weight: approx. 40Kg, and
- Size: Antenna enclosure 52 cm x 30 cm x 17.5 cm, RF unit 30 cm x 30 cm x 45 cm, data system 48 cm x 45 cm x 9 cm.

The Science Questions

This infrastructure will allow the following science questions for soil moisture retrieval from the SMAP mission to be addressed with a focus on Australia conditions:

- Algorithm development for active microwave soil moisture retrieval only and passive microwave soil moisture retrieval only.
- Downscaling techniques using combined active/passive microwave observations for high resolution soil moisture retrieval.
- Data fusion techniques for improvement of passive microwave soil moisture retrieval using radar by-products (surface roughness, vegetation indices).
- Development of surface freeze/thaw active microwave retrieval algorithms.
- Detection of standing water (water bodies, flooded paddocks) using active microwave.

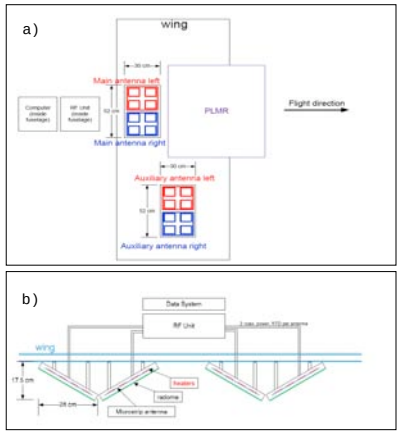

Fig 3: PLIS and PLMR equipment layout a) top view, b) front view.

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